# An Overview of Satellite-Based Precipitation Estimation With Respect to Flash Flood Modeling and Forecasting

**Timothy B Love, NOAA Climate Prediction Center, USA**

Rainfall incipient on the Earth's surface is a spatially continuous, yet nearly discontinuous phenomenon that demands the most appropriate technique for measuring its quantity at any given location over a given time. The ancient, yet usually reliable technique of approximating precipitation using a network of rain gauges works well when a general overview of surface rainfall is required, though the spatial density of these rain gauges is not sufficient in most cases to provide a detailed perspective that may be needed for applied modeling techniques. There may not be a dense enough network of gauges to accurately capture the highly varied nature of rainfall. Therefore, the use of satellite-based precipitation estimation technology is crucial in enhancing derived rainfall fields. Incorporating satellite-based rainfall estimates into daily precipitation monitoring allows the creation of a spatially continuous gridded dataset, using area averaged remotely sensed information rather than strictly an interpolated point-based rain gauge field. The result, especially in areas with a poor distribution of rain gauges, is a value-added estimate of rainfall that is readily introduced into hydrological models.

There are three primary satellite based instruments that are used to estimate precipitation over Central America. They are the geostationary Infrared sensor, the polar orbiting Microwave sensor, and the TRMM Precipitation Radar. Each relies on a different technique to estimate rainfall. The Infrared (IR) sensor aboard the NOAA GOES satellite detects radiation within the IR wavelengths that is emitted from the nearest surface beneath the satellite. This radiation is converted to a temperature, and may be then correlated to surface-based rainfall based on an assumption such as that colder cloud temperatures indicate clouds of higher vertical extent, and thus may be producing more rainfall. The Microwave (MW) sensor aboard NOAA, DMSP, and TRMM satellites attempts to estimate rainfall based on a more physical method than does the IR sensor. Radiation received from the MW sensor is emitted from sources such as liquid water droplets or suspended ice particles. Surface-based rainfall is thus correlated to the extent and composition of actual water in the atmosphere. The TRMM Precipitation Radar (PR) is an active sensor that measures the change between emitted and returned radiation due to atmospheric water particles and relates this to previously determined surface rainfall intensity.

Considerations must be taken into account for flash flood monitoring and forecasting purposes that otherwise may not receive such importance. Other than rainfall estimate accuracy and spatial resolution, the timeliness of data availability is extremely important. Many satellite-based rainfall estimates exhibit a time lag that may be too extreme for use as input to flash flood modeling. Data manipulation and accuracy correction must be performed in near real time to provide an early warning of potential flooding. In some instances a combination of rainfall estimate products would be used in a prudent manner such that a quickly available product would be used as a first guess while a lagged estimate would serve as a later, more accurate dataset. A variety of international organizations have developed sound methodologies that account for these issues while incorporating satellite-based rainfall estimates into products readily used for flash flood monitoring.